

ECON 203.01 - Problem Set 9

May 4, 2026

1. Consider the market for new cars. Suppose there are two types of new cars available at dealerships - good cars and bad cars (i.e. lemons), which break down often. The fraction of lemons at any dealership is x . The seller does not differentiate between good cars and lemons - meaning there is no big sign stating whether or not a car is a lemon; the seller sells any car on the lot for the sticker price on each car. Buyers cannot tell good cars from lemons, but they know that a proportion x of cars at any dealership are lemons. Once they have bought the car and owned the car for a while, the buyer can tell whether or not they have bought a lemon. The good cars are valued at \$2000 and lemons are worth \$1000.
 - (a) What does asymmetric information mean in this context?
 - (b) What is the equilibrium price for new cars? (Hint: This price will be in terms of x)
 - (c) Now, consider the used car market. Assume that used car sellers are willing to sell their cars at 20% below their new value but buyers do not know this. Given that good cars are valued at \$2000 and lemons are worth \$1000, what are the price ranges at which used car sellers are willing to sell their cars?
 - (d) Assuming that cars do not deteriorate, could there be any gains from trade from each sale?
 - (e) Let $x = 0.4$. What is the average value of a used car to a buyer? Will both good used cars and lemons be sold in the market? If so, does either the buyer or the seller get to keep any surplus?
2. A monopoly insurance company provides accident insurance to two types of customers: low risk customers, for whom the probability of an accident is 0.25, and high risk customers, for whom the probability of an accident is 0.5. There is an equal number of both types of customers. Without insurance, each customer's wealth is 16 if there is no accident, but 0 if there is an accident. Customers' utility of wealth is $u(w) = \sqrt{w}$. The insurance company cannot identify the type of a customer when the customer applies for an insurance contract. Suppose the insurance company offers the following two contracts. The first contract offers a payout of 8 in case there is an accident, and requires customers to pay a premium of 7. The second contract offers a payout of 16 in case there is an accident, but requires customers to pay a premium of 10.
 - (a) Determine for low and high risk customers which if any of these contracts they will buy.
 - (b) Does the insurance company manage to screen its customers with these contracts?
 - (c) Calculate the insurance company's expected profit if it offers these contracts.

3. Firms Astrazeneca and Biontech produce vaccinations and serve the same market. They have a constant average cost of \$2 per unit. The firms can choose either a high price, \$10, or a low price \$5 for their vaccinations. When both firms set a high price, total demand equals 10,000 units which are split evenly between the two firms. When both set a low price, the total demand is 18,000, which is again split evenly. If one firm sets a low price and the second a high price, the low-priced firm sells 15,000 units, the high-priced firm only 2,000 units. Analyse the pricing decisions of the two firms as a non-co-operative game.

(a) Construct the pay-off matrix, where the elements of each cell of the matrix are the two firms' profits. (b) Determine if either player has any dominant strategy. Define the equilibrium if it exists. (c) Explain why this game is an example of the prisoners' dilemma game.

4. Consider the game between two players represented by the following bimatrix (in each cell first entry shows the utility of player 1, second entry shows utility of player 2:

	L	M	R
U	(1, 0)	(2, 5)	(-2, -1)
D	(2, 1)	(2, 1)	(-1, 0)

(a) Is there a strictly dominant strategy equilibrium of this game? Explain. (b) Is there a weakly dominant strategy equilibrium of this game? If you apply iterated elimination of weakly dominated strategies, does the order of elimination make difference? Explain.

5. Consider the following game

	P	Q	R
K	(3, 1)	(x , 3)	(0, 4)
L	(1, y)	(2, 0)	(1, 1)
M	(z , 2)	(4, 1)	(2, w)

(a) If $x = 5$, $y = 2$, $z = 4$ and $w = 3$, find all the pure strategy Nash equilibria of this game. (b) For what values of x, y, z, w does the game have a strictly dominant strategy equilibrium?

6. (3 Player Simultaneous Game)

If player 3 plays A, then the payoff matrix becomes:

	P	Q
K	(3, 2, 1)	(2, 1, 1)
L	(2, 2, 0)	(1, 2, 1)
M	(3, 1, 2)	(1, 0, 2)

If player 3 plays B, then the payoff matrix becomes:

	<i>P</i>	<i>Q</i>
<i>K</i>	(1, 1, 2)	(2, 0, 1)
<i>L</i>	(1, 2, 0)	(1, 0, 2)
<i>M</i>	(0, 2, 3)	(1, 2, 2)

Find all pure strategy Nash Equilibria.

7. Two people enter a bus. Two adjacent cramped seats are free. Each person must decide whether to sit or stand. Sitting alone is more comfortable than sitting next to the other person, which is more comfortable than standing.

(a) Suppose that each person cares only about her own comfort. Model the situation as a strategic game. Find its Nash equilibrium/equilibria. (b) Suppose that each person is altruistic; ranking the outcomes according to the other person's comfort, and, out of politeness, prefers to stand than to sit if the other person stands. Model the situation as a strategic game. Find its Nash equilibrium/equilibria. (c) Compare the people's comfort in the equilibria of the two games.

8. Consider the following game

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
<i>K</i>	(8, 3)	(1, 3)	(7, 5)	(1, 3)
<i>L</i>	(4, 8)	(15, 4)	(9, 5)	(0, 5)
<i>M</i>	(1, 5)	(14, 14)	(4, 16)	(2, 1)
<i>N</i>	(4, 3)	(7, 2)	(7, 4)	(3, 5)

(a) Find all the best responses of both parties, for one person and one strategy explain why it is a best response in detail. (b) Find the pure strategy Nash equilibrium of this game. (c) Find the dominated strategy/strategies in this game. (d) Find the set of strategies that survives iterated deletion of dominated strategies. (e) Find the set of Pareto Efficient payoffs in this game. (f) What does this game illustrate about the relationship between Nash equilibria and Pareto Efficiency?

9. Player 1 can choose strategies $X = 1$ or 2 , Player 2 can choose strategies $Y = 1, 2$ or 3 . If $X + Y = 5$ then both players get 0. Otherwise the players get the amount they choose. Write down the payoff matrix for this game and find the Nash equilibrium/equilibria.

10. The following is what is known in game theory as the Chicken Game.

	<i>Swerve</i>	<i>Straight</i>
<i>Swerve</i>	(0, 0)	(-1, 1)
<i>Straight</i>	(1, -1)	(-5, -5)

Find all (pure and mixed) Nash equilibria of this game.

11. Find all Nash equilibria (Mixed and pure) of the following game

	P	Q	R
K	(3, 5)	(5, 3)	(3, 4)
L	(1, 2)	(2, 0)	(1, 1)
M	(4, 2)	(4, 1)	(2, 3)

12. Find all (pure and mixed) Nash equilibria of the game below.

	U	D
A	(50, 200)	(-250, 0)
B	(45, 0)	(-100, 10)
C	(30, 10)	(30, 30)

13. Geralt and Zoltan are roommates. Each of them prefers a clean room to a dirty room, but neither likes house cleaning. If both clean the room, they each get a payoff of 5. If one cleans and the other doesn't clean, the person who does the cleaning has a utility of 4, and the person who doesn't clean has a utility of 6. If neither cleans, the room stays in a mess and each has a utility of 3. The payoffs from the strategies 'Clean' and 'Don't Clean'. Find all pure and mixed strategies.